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INFORMATION OVERLOAD:
TACTICAL INFORMATION PROCESSING IN DIVISIONS
AND CORPS

A Monograph
by
Major Kevin P. Anastas



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ABSTRACT

INFORMATION OVERLOAD: TACTICAL INFORMATION PROCESSING IN DIVISIONS AND CORPS by MAJ Kevin P. Anastas, USA, 60 pages.

This paper seeks to determine if the U.S. Army tactical information processing system is suitable for current AirLand Battle doctrine and future AirLand Operations. The pace of warfare has increased dramatically in the twentieth century, especially since World War Two. In order to keep up with this increase in tempo, command and control (C²) systems are forced work through decision cycles faster and faster. This monograph examines the factors that determine how fast modern staffs can complete the observe-orient-decide-and act loop (OODA Loop). If the commander and staff acquire and process information too slowly, then combat units will not be able to maximize their combat power.

The criteria used to evaluate command and control systems is specified in Field Manual 100-5: "The ultimate measure of command and control effectiveness is whether the force functions more effectively and more quickly than the enemy." With this as an indicator of success or failure, this monograph looks at several theoretically "ideal" systems, some relevant historical examples, and our current capabilities. The theories include one concerning information processing, COL Boyd's OODA Loop, and Martin Van Creveld's C² theories as presented in his book *Command in War*. For historical examples, the paper considers WWI, WW II and the Arab-Israeli Wars. In the final section, this paper relies on Battle Command Training Program (BCTP) results and the incomplete DESERT STORM after action report for an assessment of where we are today and what we need in the future.

The evidence presented by this monograph indicates that the performance of our current C² systems in DESERT STORM and in BCTP indicate serious flaws that could prevent our large units from being as agile as they will need to be on the battlefields of the future.

Table of Contents

I. Introduction.....	1
II. Theory.....	4
Pipelines, Alarms, and Trees	8
OODA Loop	13
Centralized vs Decentralized	14
III. Historical Background	16
WW I.....	17
WW II.....	21
Arab-Israeli Wars	27
Synthesis, Theory and History	29
IV. Contemporary and Future.....	32
Current	32
Observe-Orient	32
Orient-Decide	34
Decide-Act	37
Future	40
V. Conclusions	41
APPENDIX A.....	45
Endnotes.....	46
Bibliography	57

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I. Introduction

During WARFIGHTERS, most CPs suffer from an information overload. High-tech tactical operations centers (TOCs) frequently become inundated with computer paper, which blocks commanders and staffs from finding what they really need.

Battle Command Training Program¹

The hallmark of mechanized warfare since its introduction in the early twentieth century has been speed. We can trace a tremendous increase in the pace or tempo of operations from the introduction of mechanically reliable mechanized forces during the Second World War. The overall increase in operating tempo dramatically affected both the planning and execution of campaigns. Brigadier Richard Simpkin, a noted military writer and advocate of maneuver warfare, tried to quantify this increase. He claimed that the Soviets have reduced the time from receipt of a mission until execution by a factor of between three and four since 1945. In real terms, he estimated that a 1980 Soviet tank army could plan an operation in four or five days compared to about fifteen days for its World War Two counterpart. This environment of continuously increasing tempo defines the background climate in which we must conduct our future AirLand Operations.²

In this environment, the importance of rapidly acquiring and processing information is obvious. Since the environment is changing at a rapid rate, we must continually challenge our doctrine and procedures to ensure that they remain appropriate for conditions on the modern battlefield. The purpose of this paper is to determine if our tactical information processing system is suitable for current AirLand

Battle doctrine and future AirLand Operations. The scope of this study includes the entire command and control (C²) decision cycle.

I intend to analyze the effectiveness of our information management systems (historical, current, and future) using criteria developed from the tenets of AirLand Battle. Since AirLand Operations will continue to recognize these tenets, my criteria is also appropriate for analyzing proposed changes to the current FM 100-5.

All four tenets recognize the increased tempo of modern warfare. The tenet *Initiative* stresses the importance of thinking ahead of and reacting faster than the enemy. Both of these points are key functions of the C² system and depend on the rapid flow of critical information. The tenet *Agility* succinctly defines the problem as, "The ability of friendly forces to act faster than the enemy." The essence of this tenet is to get inside the enemy's decision cycle (Observe, Orient, Decide, Act [OODA] Loop). This is the key characteristic of any command and control system. To exploit *Depth* in operations, commanders must "see beyond the requirements of the moment, [and] actively seek information on the area and the enemy in depth." This refers to the importance of anticipating the actions of the enemy and initiating timely countermeasures—clearly an important requirement of our C² system. Finally, the tenet *Synchronization* "requires anticipation, mastery of time-space relationships, and a complete understanding of the ways in which friendly and enemy capabilities interact." All of these depend on rapid transmission, evaluation, and presentation of information.³

Based on these tenets, FM 100-5 clearly states the criteria against which any command and control system must be evaluated. The section outlining command and control requirements concludes that, **"The ultimate measure of command and control effectiveness is whether the force functions more effectively and more quickly than the enemy."**⁴ This is the criteria I will use to evaluate past, present and future systems.

I plan to look for possible solutions to the problem by first examining the relevant theory. I will briefly review some of the ideas of classical theorists to illustrate how the same problems existed in the past, and to show how the situation has changed for the modern commander.

This paper will consider three relevant theories of information management and decision making. The first concerns modes of information transfer. The second deals with a theory of decision cycles. The third presents a more complete theory of command systems. These three theories will help us understand what capabilities an ideal system should include and provide a basis for comparison with our current and future systems.

The second major portion of this paper will present information management systems from three distinct historical periods. I begin with a look at the First World War since the U.S. Army adopted its current staff organization during this period. It is also interesting to start with World War One because it provides us with a baseline that is almost the antithesis of modern mobile war. My second historical period is World War Two. This represents the last major U.S. conflict

where large-unit mobile warfare took place. For my third example, I chose the Arab-Israeli conflicts of 1967 and 1973. These represent the greatest mechanized conflicts between World War Two and DESERT STORM. The tempo of these wars is probably more representative of the AirLand Operations environment than our own experience in Vietnam. The overall purpose of this section is to ensure that the theories are not contradicted by reality; and to see if we might get some ideas about where to go in the future.

Finally, I plan to use lessons derived from the theories and historical examples along with my evaluation criteria to critique our current systems and suggest some implications for the future.

II. Theory

The primary purpose of any theory is to clarify concepts and ideas that have become, as it were, confused and entangled.⁵

Clausewitz

Perhaps the most important role of theory is to simplify complex issues so that we can better grasp the whole picture. In this section, I will present the relevant theory of tactical information management and attempt to draw some conclusions that can serve as guides in evaluating current problems. By looking at the qualities of an "ideal" system of information management, we may be better able to understand reality. I will begin with the classical theorists and conclude with some of the most recent thoughts on the subject.

The nature of war before the late nineteenth century made the problem of information management quite different from the challenge modern commanders face. According to historian John Keegan,

the essential requirements for action by a commander have been *knowing* and *seeing*. By "knowing," Keegan means understanding the environment and having the background knowledge required to understand the context of the problem. Knowing includes both general facts such as geography, climate, and terrain, as well as particulars like equipment, unit strengths, morale etc. By "seeing," Keegan refers to the commander having a dynamic image of the battlefield that allows him to understand what needs to be done.⁶ In early times this was relatively simple since commanders were generally able physically to see a major portion of the comparatively small battlefields. They were thus able to acquire "real time" intelligence, process it instantly, issue orders immediately, and then monitor the effects.⁷ The distances and quantity of information had not yet exceeded the ability of an individual to cope effectively with the situation.

Although pre-industrial age warfare was simpler than it is today, the classical theorists clearly understood the importance of information for the commander. Sun Tzu identified the basic kinds of information the commander needs when he advised leaders to:

Know the enemy and know yourself; in a hundred battles you will never be in peril. When you are ignorant of the enemy but know yourself, your chances of winning or losing are equal. If ignorant both of your enemy and of yourself, you are certain in every battle to be in peril.⁸

This assessment is as valid today as when it was written. One example that illustrates this is the fact that our modern five paragraph field order begins with an assessment of both enemy and friendly situations.

The basic methods of acquiring and processing tactical information did not change during the two thousand year period between the time of Sun Tzu and that of Carl von Clausewitz. Basically, both periods relied on horse mounted couriers to pass tactical information. Despite this similarity, however, war was changing and Clausewitz identified several new concepts that help us understand it better.

Clausewitz's main contribution to tactical information theory is his concept of friction. In his chapter on "Military Genius", he noted that in war, "The latest reports do not arrive all at once: they merely trickle in. They continually impinge on our decisions, and our mind must be permanently armed, so to speak, to deal with them."⁹ In another passage concerning intelligence in war, he noted that, "Many intelligence reports in war are contradictory; even more are false, and most are uncertain."¹⁰ This uncertainty or inability of the commander to see the battlefield clearly is one of Clausewitz's four elements that contribute to friction, and together they make up the climate of war.¹¹

Clausewitz's counter to friction in general and uncertainty in particular was to select the right man as the commander. Instead of recommending a process to deal with this problem, Clausewitz concluded that only a commander with determination and *coup d'oeil* (genius) could make the right decisions under the fog and pressure of combat.¹² His early nineteenth century solution of choosing the right leader was simple in concept, but somewhat difficult to put into practice. Geniuses were no easier to identify in Clausewitz's time than they are today. While armies grew in size and capability, the modern staff developed to help commanders manage increasingly complex

military problems. The collective genius of the staff helped reduce uncertainty so that the commander could make better decisions. If the traditional one-man operation of Clausewitz's time had problems with information flow, one can well imagine the impact these elements of friction had on the complicated general staffs required to run modern, machine-age armies.

In his book, *Command in War*, Martin Van Creveld concluded that during the age of railroads, rifles, and telegraphs, the size of the battlefield and the quantity of information available exceeded the capacity of any one man to collect and digest it. The fact that electronic communications (in the form of the telegraph) and general staffs began to appear at about the same time seems to corroborate this assertion.¹³ Large staffs became necessary to process the data pouring in over the wires or from couriers traveling by railroad. While more information would seem to help the commander make better informed decisions, Van Creveld clearly identified the down side of information overload.

The more the available information, however, the longer the time needed to process it, and the greater the danger of failing to distinguish between the relevant and the irrelevant, the important and the unimportant, the reliable and the unreliable, the true and the false.¹⁴

The vicious cycle of increasing amounts of information requiring more people to process it and resulting in less timely input for the commander continues to this day.

The rate of increase in the amount of information available to the commander has grown exponentially, especially since 1939.¹⁵ In his

book, *The Evolution of Modern Land Warfare*, Christopher Bellamy estimates that the space occupied on the battlefield by each man increased by a factor of ten from the American Civil War to World War One and another factor of ten between the First and Second World Wars. The dramatic increases in size of armies, weapon lethality, and the spectrum of technology exploited for military purposes during this period are equally remarkable.¹⁶ Increased distances, larger armies, and the products of the industrial revolution combined to produce a much more complex environment for modern commanders. This climate requires more information to be processed faster than ever before in history.

The purpose of this study is to analyze tactical information problems and draw some conclusions that might help us as we attempt to reduce uncertainty on the modern battlefield. One way to approach this problem is to theoretically construct the ideal system and then compare the performance of our actual and proposed processes. This is somewhat similar to Clausewitz's comparison of absolute war and real war. For my "ideal" system I will present three overlapping theories of tactical decision making. Proceeding from the specific to the general, these address modes of information transfer, a theory of decision cycles, and finally, a complete theory of command systems.

Pipelines, Alarms, and Trees

A 1989 report done for the Army by the RAND Corporation entitled *Understanding Commanders' Information Needs* took a somewhat unique approach to the study of information overload. Instead of simply cataloging specific pieces of information

commanders need, this report focused on the conceptual framework of the management process. It sought to understand why people communicate and what they use information for. Other studies have simply listed the contents of messages and noted when and with whom staff sections coordinated. Most of them focused on identifying lists of critical information needs. The RAND report took a more theoretical look at information flow in military organizations.¹⁷

The authors believe that it is unrealistic to attempt to reduce critical information requirements down to a "slim volume of essentials." They argue that "war is too complex and the variables too complicated to provide a formula for a set of information that would be adequate over all conditions."¹⁸ Clausewitz, Jomini, and most other students of the military art would almost certainly agree.¹⁹ Considering the normal American tendency to seek technological solutions to problems, this study seems to take an unusually sensible approach and I believe it offers a valuable perspective on current problems.

One of the more useful concepts of the study concerns the modes of information exchange that occur between commanders and staffs and between various command posts.²⁰ The essence of the theory is that organizations transfer information in three basic ways. These modes of communication present in all information systems are: **pipeline, alarm, and tree**. By using these theoretical categories as a conceptual framework, the authors believe we can better understand how the process works.

The **pipeline** mode of communication transmits predetermined information to the staff and commander through standardized, reports and briefings. The purpose of the pipeline is to provide background information that sets the stage for the commander. It transmits information according to a set order, in an established format, and usually at a scheduled time. The pipeline mode is well suited to provide information for decisions whose parameters are known in advance. To be effective, commanders and staffs must determine what information they think will be important before operations begin.²¹

The pipeline mode alone cannot provide all the information the commander needs to make decisions. Pipeline data cannot help the commander and staff if they do not correctly predict what information they will need. Since it is difficult to anticipate what will be critical in any given situation—especially in mobile warfare—staffs usually stuff the pipeline to the limit. This leads to the common perception today that command posts are swamped with useless information.²²

The **alarm** mode of communication is a technique for filtering the reams of useless data in order to highlight to the commander the really critical information he needs. The purpose of the alarm mode is to alert the commander and staff that the plan requires corrective action. Alarms can be set explicitly by identifying certain bits of pipeline information as critical (e.g., Commander's Critical Information Requirements [CCIR]). Many alarms, however, are identified implicitly by subordinates who understand the commander's intent. When the staff detects an event that invalidates the plan, the alarm goes off and they start working to correct the problem. While some explicit alarms

can be monitored through automated systems, humans must identify unanticipated show-stoppers. Once an alarm has indicated that a problem exists, the commander and his staff must gather other information they will need to solve it.²³

The **tree** mode seeks to gather information either prior to a problem occurring or once an alarm has been activated. The unfortunate name used by the RAND study group for this mode refers to a decision tree like progression that the inquiry can take. This implies that the next piece of information needed is dictated by what the last bit contained. The term "query" perhaps better describes the process. The tree mode is essentially a demand-pull search for information. In the pipeline mode, the staff had to determine what general information to collect prior to the operation. The tree mode, on the other hand, gathers information on a specific problem *once one has been identified*. Instead of making subordinates report everything all the time, the tree mode focuses on the critical information only. This saves time for both subordinates (since they have fewer reports to make) as well as the headquarters staff (since they have much less data to process).²⁴

Commanders query their subordinates using several techniques. From fastest to slowest these are: by going forward themselves, by sending "directed telescopes" to go where they cannot, and by calling for information through normal reporting channels. The original solution was simply to go to the area of crisis themselves and directly observe the situation. Commanders greatly speed up the decision cycle when they directly observe events since seeing with their own

eyes reduces uncertainty. This technique is also faster because there is no staff or estimate process involved.²⁵ Modern commanders can only physically see a tiny portion of the battlefield but this technique is still successfully employed and remains an important part of our doctrine.²⁶

When conditions made it impossible for commanders to see the whole battlefield, they often sent staff officers or aides to serve as extensions of their eyes. Van Creveld summed up the focused nature of their mission when he labeled these officers "directed telescopes." This technique somewhat reduced uncertainty since most "directed telescope" systems relied on hand picked, well trained people who could be trusted to give accurate reports.²⁷

Staffs also employ standard communications means to get special reports from units. If the data is not immediately available or the unit does not understand the importance of the query, then the answer will at best be delayed and at worst be inaccurate when it finally arrives. This is the slowest of the three techniques but may be the only one available. Sometimes "directed telescopes" have to be sent to confirm the accuracy of the reports before a commander will make decisions based on information reported in them.²⁸ This checking slows down the entire process. For example, during a recent Battle Command Training Program (BCTP) exercise, one commander told his staff to treat all information received as a lie until they could independently confirm it.²⁹ No matter what technique the commander uses, the tree or query mode allows him to gather the specific information he needs to make critical decisions.

Pipelines, alarms, and trees are not conflicting processes but parts of a hybrid system. Each has a role to play in getting information from the source to the commander in a timely manner. When events match the commander's image of what should be happening, he and the staff monitor them through pipeline reports and some "directed telescopes." They use alarms, either explicit or implicit, to screen the incoming data and to give them warning that something has changed. Once the alarm identifies a problem, the commander can use the tree mode to query subordinates for more information. This query can take the form of directly observing the event or repositioning a "directed telescope" to provide feedback. All three modes are designed to reduce uncertainty by providing him with timely information (see Appendix A, Fig. A-1 for a comparison of the three modes of information transfer).³⁰

The RAND Corporation theory provides some insight into the workings of an information system, but it does not give us an overall framework to understand the commander's decision process. We must now turn to a more general theory of decision making to get this broader perspective.

OODA Loop

In the early 1980s, Colonel John Boyd (USAF, Retired) developed a theory of maneuver warfare based on an analysis of air-to-air combat. Boyd contends that conflict can be theoretically viewed in terms of a time-competitive observation-orientation-decision-action cycle (OODA Loop). Decision makers on both sides **observe** themselves, their surroundings, and the enemy³¹. They then **orient**, or develop

an image of their situations. Based on this orientation, they make **decisions** and then **act** to put them into effect. If one side can consistently go through the OODA Loop faster than the other, they will probably beat an enemy that takes longer to complete the cycle.³²

With some slight modifications, we can use this simple, intuitive theory as the basis for our analysis. Colonel Boyd based his model on the key actions a decision maker must take to go from observation to action. If we link the key actions with the connecting threads of the process, we get a slightly more realistic picture and a model we can use for our analysis. Since commanders can no longer physically see the entire battlefield, we have to consider the problem of communications between the observation and orientation nodes (see Appendix A, Figure A-2). Between orientation and decision we must consider the staff estimate process. Finally, between decision and action, the staff has to prepare and issue the order. Each of these connecting threads contain the potential for delay. Since the whole purpose is to get inside the enemy's decision cycle, these time delays could be critical to the ultimate success of the mission.

Centralized vs Decentralized

We have so far discussed a theory of information flow and a decision cycle theory. The third and most complete theory we will examine is the command concept outlined in Martin Van Creveld's book *Command In War*. In it he argues that there are only two ways an organization can confront the problem of having less information available than it needs to perform a task.

One is to increase its information-processing capacity, the other to design the organization, and indeed the task itself, in such a way as to enable it to operate on the basis of less information. . . . These approaches are exhaustive; no others are conceivable. A failure to adopt one or the other will automatically result in a drop in the level of performance.³³

The basic choice then, is whether a command system should be centralized or decentralized.

Van Creveld concludes that the decentralized command system has proven itself superior to centralized ones and "will probably remain superior to them in every case" in the future.³⁴ He argues that increasing the processing capacity of an organization results in an increase in the size and complexity of the staff; and is thus ultimately self-defeating. His preferred option is to divide the task into various parts and establish forces capable of dealing with each of these parts separately on a semi-independent basis. Organizations must be designed to operate with as little information as possible, since any increase in information flow will slow down or even stop the process.

These three theories together suggest several points to keep in mind when we attempt to evaluate command and control systems. The various modes of communications must quickly alert the commander when actual events deviate from his image of the battlefield. The OODA Loop theory argues that successful commanders must process the information, decide, and act faster than the enemy. And finally, Van Creveld's theory suggests that the only way we can have an agile command and control system is to decentralize decision making authority in order to restrict the amount of information that must be processed. All three theories seem to be compatible with our

initial criteria which contends that the ultimate test of a command and control system is whether the force functions more effectively and more quickly than the opposition.

The whole purpose of processing tactical data is to provide the commander with information so that he can make better decisions. In Clausewitz's terms, staffs exist to reduce the level of uncertainty for the commander. Theory gives us ideas about how an ideal system might work. History can also provide insights that may prove valuable as we attempt to design our command and control systems for the future.

III. Historical Background

These difficulties [concerning uncertainty], therefore, demand confidence and firmness of conviction. That is why the study of military history is so important, for it makes us see things as they are and as they function. The principles which we can learn from theoretical instruction are only suited to facilitate this study and to call our attention to the most important elements in the history of war.³⁵

Clausewitz

The U.S. Army adopted its current staff structure during our involvement in the First World War. We made some changes to the structure in order to meet the more mobile conditions of World War Two. Since then, the Israelis have conducted the largest, high tempo, mobile operations. In this section, I will highlight some key aspects of each of these three periods. This evaluation should provide some insights and help us determine where we, as an army, should be headed in the future.

WW I

The communications technology of the First World War forced commanders into a no-win situation. The mainstay of communications during this war was the land-line field telephone. If a commander wanted to stay in touch with all of his dispersed units, he had to position himself where the wires came together. Of course this was usually a telephone exchange somewhere in the rear. If he tried to go forward with the advancing troops, his wire communications were inevitably cut soon after crossing the line of departure (LD) and he was left commanding only those troops within earshot. On the other hand, if he chose to stay in the rear where he could communicate with all of his units, he quickly had no information at all. Units going "over the top" immediately lost contact when artillery fire cut their wires. A commander of this era could go forward and be in charge of a few soldiers throughout the battle or stay in the rear and be in control of all of them until the battle began. This peculiar set of conditions describes the climate in which "chateau generalship" became the norm.³⁶

The wire communications of this period made the pipeline mode the pre-eminent method of communications transfer, and ultimately led to larger, less mobile staffs. Since the Western Front hardly moved for over three years, armies installed fixed wire lines and staffs demanded more and more detailed reports from the front line troops. The large amount of data required larger staffs to process it. Even the American Expeditionary Force, which was in combat for less than eighteen months, saw its division staffs double in size in order to cope with the conditions on the Western Front.³⁷ This ponderous system worked well during the preparation stages of operations since

centralized planning was more efficient and planning time was not critical. Once the battle began, however, the vast bureaucracies were incapable of tracking the action and did little to help the commander make informed decisions.

The information collection, transmission, and processing system of the First World War was inadequate for both sides, but particularly for the attacker. This was mainly due to the state of the technology, but partially to the failure of most commanders to recognize and address the problem. The defender, who fell back on intact communications, could generally stiffen the defense in a particular spot faster than the attacker could penetrate it.

While there are any number of examples that illustrate the failure of communications in the Great War, the breakdown of the British command system during the Somme offensive of 1916 is perhaps the most tragic. On 1 July 1916, the British Empire suffered 60,000 casualties including 20,000 dead—the heaviest rate ever sustained by the British Army. They made this almost unimaginable sacrifice and still failed to reach any of their initial objectives.³⁸ At his headquarters fifteen miles behind the front, the commander of the British Expeditionary Force had no idea of the magnitude of the disaster. In fact, Sir Douglas Haig concluded on the first day of the offensive that, "Reports . . . seemed most satisfactory."³⁹ When told about the meager gains in front of one of his corps, Haig noted in his diary that, "I am inclined to believe from further reports, that very few of the 8th Corps left their trenches." The soldiers had in fact left their trenches and most of them had been "practically annihilated and lay shot down

in their waves."⁴⁰ Haig's staff could do little to reduce uncertainty when they had little or no information.

The key point in the decision cycle during the World War I era was the connecting thread between observe and orient (see Annex A, Fig. A-2). The information transfer system based almost completely on bottom-up reports could not provide the commander or the staff with accurate data in a timely manner. The bloated and immobile staffs of this period would probably have had trouble coping with a rapidly changing situation even if they had the necessary information. They could not, however, process what they did not have. Lack of an accurate, real time information system was the key problem of the period.

Despite the technological constraints of this era, some innovative thinkers recognized the importance of having multiple information sources to gather data (similar to the "hybrid" system the RAND study calls for).⁴¹ Colonel George C. Marshall made a particularly novel effort at solving the problem while serving in the operations section of the American Expeditionary Force (AEF) staff. Marshall sent a junior officer instructed in the handling of carrier pigeons to accompany each of the lead battalions of the assaulting divisions during the Meuse-Argonne offensive in November 1918. He gave them specific instructions to release pigeons at particular times and with specific information. This included the exact location of the lead units along with brief descriptions of the fighting. The experiment was a success. Marshall claimed that:

Every pigeon released by the officers of the Operations Section reached the army loft at Souilly, and gave us earlier information of the progress of the attack than was obtained by the Army Corps and Division Headquarters closer to the front.⁴²

Marshall, of course, was not the only one who used pigeons to send messages in World War I, but this example seems especially interesting since it shows his desire to reestablish the pipeline information flow from the bottom-up.

Of all the armies of this era, the Germans were probably the best at understanding the importance of multiple modes of information. Their 1918 offensive called for several redundant systems of information transfer. In addition to the normal wire communications, they experimented with flares and messages carried by aircraft.⁴³ They also developed a system of "directed telescopes" to report directly back to higher headquarters concerning the front line units. These staff officers suffered under the same communications difficulties as everyone else, but having dedicated officers to perform this task was an improvement over other existing systems. For example, Haig had no comparable organization during the Somme offensive.⁴⁴

While these initiatives were commendable, they serve to highlight the poor state of information flow in First World War armies. Higher headquarters staffs were starved of all types of information because the pipeline mode was severed as soon as the battle started. Since information was not available, the alarm mode had no information to consider. The only way to get information was through queries or "directed telescopes" aimed at gathering specific data.

The staff system that evolved from these conditions was not suitable for other styles of warfare. Since the communications nodes were well to the rear and the front was stationary for over three years, CPs became static and were designed to do detailed, deliberate planning. The large bureaucracies that grew during this period focused on collecting all sorts of information, little of which had a direct bearing on combat performance. Luckily, speed was less important than accuracy during the planning phase of these set piece battles. This trend in staff development is still significant today because our current staff organization is based on the one established during this period.⁴⁵

The comment of General Haig's chief of staff when he finally saw the appalling conditions of the Paschendael battlefield sums up the information problem during World War One: "Do you mean to tell me that the soldiers had to fight under such conditions? Why was I never told about this before."⁴⁶ If the ability of a force to function more effectively and more quickly than the enemy is the ultimate measure of command and control effectiveness, we must conclude that the C² systems of the First World War were inadequate due to the lack of accurate, timely information.

WW II

The amount of information available to a tactical commander began to increase exponentially in 1939. Not only did the types of weapons multiply, but acquisition systems, weapons ranges, and the overall synchronization problems were substantially greater than those of the First World War. Perhaps because of this revolution in

information, successful mobile commanders did everything possible to reduce the amount of data that their staffs had to process.

The single most important technological device that helped them both reduce the quantity and speed up the rate of information transfer was the radio. This innovation allowed the commander to go forward and directly observe the battle similar to the way commanders had in the pre-industrial armies.⁴⁷ Retired division and corps commanders from World War Two estimated that they spent no more than 25% of their time at their command posts. They spent the remaining 75% in the field visiting subordinates, viewing the front, and controlling operations.⁴⁸ When you consider where their World War One counterparts spent their time, you begin to understand the nature of the revolution that had taken place. By maintaining radio contact with his staff, a commander could see what was going on at the decisive point and still monitor events throughout his area of responsibility. Several American officers excelled in the way they constructed their command systems to meet the requirements of modern mobile warfare. Of these leaders, Major General John S. "P" Wood at the division level and General George S. Patton at the corps level and above are the best examples.⁴⁹

The 4th Armored Division was informally known as "Patton's Best" and its commander set the pace. Russell Weigley, in his book *Eisenhower's Lieutenants*, called Wood, "one of the best of the division commanders—perhaps the very best."⁵⁰ General Jacob L. Devers described "P" Wood's command system as follows:

He issued his orders orally and left his staff to write them up in proper form and simple language so that each element knew just what it had to do. He then went where the going was roughest, and provided the effective leadership because he took full advantage of the time element.⁵¹

Wood used his staff not to process reams of reports from subordinates but, in Wood's own words: "My staff was occupied mainly in keeping contact with me and seeing that my directions for supply and maintenance were carried out."⁵² Based on this short background, we can consider the impact Wood's system had on information flow and the decision cycle.

Every piece of General Wood's command system was tailor made to insure that 4th Armored Division cycled through the OODA Loop faster than the enemy. Wood was always forward observing the action at the decisive point. He claimed that, "If you can't see it happen, it's too late to hear about it back in a rear area and meet it with proper force."⁵³ Wood considered ground transportation too slow and usually traveled in a Piper Cub with red streamers flying from the tip of each wing. Once he received orders from higher, he flew directly to the command tanks of his Combat Commands (CC). These tanks would display a large "A" or "B" on their turrets when his plane flew over. General Wood made his own command estimate enroute to the forward positions and, once there, gave his subordinates succinct orders: "here's your boundaries, the units left, and right and following us and the first, second and third objectives—let's get at it right now!"⁵⁴ Clearly Wood followed Patton's maxim that "the best is the enemy of the good" and went for the 80% solution now rather than 100% later.⁵⁵ This system greatly compressed the connecting threads

between observe, orient, decide, and act (see Annex A, Fig. A-2). Not only did he move faster than the enemy could react, but his units often were on their objectives before the written corps order even arrived at his headquarters!⁵⁶

General Patton's command system was designed to operate at a higher level than Wood's, but the objectives and principles were similar. The single most important characteristic that made his system effective was decentralization. Patton expected his division commanders to "exercise independent judgment and tactical daring"; he granted them a "freedom of action that permitted [them] . . . to be virtually independent . . ."⁵⁷ As Van Creveld theorized, this key aspect allowed a tremendous reduction in the amount of information that had to be exchanged and it increased the tempo of operations to a level that no centralized system could match. This philosophy helped a great deal, but Patton did not stop there in his attempts to speed up information flow.

Since Patton's area of responsibility was much larger than that of a division commander, he had to rely more on reports from others. To cover this larger area he essentially employed two groups of "directed telescopes" to stay informed. First, he made it Third Army standard operating procedure (SOP) that:

One officer from each Staff Section of Army and Corps will go to the front daily. Anything of vital moment obtained during the visit will be reported to the Chief of Staff immediately upon returning. The Commanding General or Chief of Staff must visit part of the front daily.⁵⁸

The second group Patton employed was basically a cavalry unit converted into an information gathering service. The 6th Cavalry Group (mechanized), also known as Patton's "Household Cavalry," became one of his major sources of information. A squadron from the group dispatched a command liaison officer patrol to each unit in contact. These teams radioed information directly to Army headquarters bypassing the chain of command in the name of speed. The liaison teams were one of the main reasons that Patton always seemed to have an "uncanny knowledge of the situation."⁵⁹

Despite the requirement for mobility in World War II, the increase in the quantity of information between the wars with no change in processing capability resulted in larger staffs. The prewar tables of organization (T/O) authorized each armored division headquarters twenty-eight officers. By 1943, this number had grown to forty-two. This increase is understandable since the World War Two staff had to synchronize many more systems over much greater distances than their World War One counterparts. With no new automation aides available, the only solution to an increase in processing requirements was more people. The obvious danger was that larger staffs were inherently slower both in the staff estimate process and in physical movement. Patton's cavalry style operations would tolerate neither.

In addition to the "directed telescopes", Patton took other precautions to insure that his headquarters would be agile in every way. The first thing he did was direct his staff to operate strictly within authorized T/O figures. As one member of his staff noted, "Patton

would not permit [additional personnel], on the ground[s] it deprived lower units of necessary personnel and impaired mobility."⁶⁰ Another way that Patton increased the agility of the staff was to bring with him people he knew and trusted from his previous assignments. Patton brought sixteen officers from Seventh Army in the Mediterranean to Third Army in England. Men who are familiar with each others' likes, dislikes, and overall abilities do not need to exchange as much information as strangers.⁶¹ One final way that Patton kept the size of his staff down was to avoid overspecialization. One example of this is the fact that his intelligence officer (G-2) Colonel Oscar Koch, was an ex-cavalryman who essentially had to learn the intelligence business from the ground up. Koch acquired a reputation as one of the best G-2s anywhere and went on to command a division in Korea.⁶²

Lessons learned from mobile armored warfare practiced by men like Wood and Patton still have relevance to us today. While their command and control systems used all three modes of information transfer, they leaned heavily on the tree or query mode. The main reason for this was the requirement for speed. Unlike the First World War, when staffs had months to plan deliberate set piece battles, Patton and his subordinates were constantly on the move. Patton told his division commanders to expect about twelve hours to prepare and issue an order.⁶³ This is still a tough standard even for divisions in today's high tempo environment. World War II armored commanders did everything they could to reduce the amount of information that had to be processed. They did this by making plans based on direct

observations, when possible, rather than drawn out staff deliberations. These World War Two examples provide a good basis for understanding mobile warfare, but we should also consider more recent examples before we project the needs of future doctrine.

Arab-Israeli Wars

The the greatest clashes of mobile armored forces between World War Two and DESERT STORM have been the Arab-Israeli conflicts. Experience in both '67 and '73 tends to support many of the same conclusions we have tentatively drawn from World Wars One and Two.

The Israeli command system of 1967 represents an extreme form of decentralization. Summing up some of the lessons of the 1956 Sinai Campaign, General Rabin concluded that:

commanders and headquarters [of armored forces] must be able to gather intelligence, process it, prepare orders, and issue them *while on the move*. . . . [they] should operate according to a method which defines objectives, targets and timetables, lays down demarcation lines between the units, and determines the general method of conducting the battle. An armored commander should be so trained as to make him as little dependent on his superior as possible in deciding how to act.⁶⁴

Several historians of the Israeli Army have concluded that the Israelis certainly were not the first to understand the advantages of a decentralized command and control system, but they should be given credit for "the first explicit method of command based directly on its needs."⁶⁵ This system of "optional control" is an extreme case and can help us to understand where to strike the balance between centralized and decentralized systems.

Analyzed from the perspective of the decision cycle, the advantages of "optional control" are obvious and most are logical extensions of the systems that the World War Two armored commanders used. The Israeli system recognized that in mobile warfare opportunities are fleeting, thus the command response must be prompt. The only way to achieve this is to have commanders well forward making decisions on the spot. They thus minimize time spent on the connecting threads of communicating, staff estimates, and writing and transmitting detailed orders (see Annex A, Fig. A-2). In the '67 War, the corps level headquarters monitored the battle by sending staff officers forward as "directed telescopes"; but higher headquarters essentially left the division commanders alone to fight their units. The only down-side to this system are the problems of coordinated action by more than one subordinate against an objective or when unexpected events or political pressures require a change to the plan.

Several of these problems with "optional control" developed during the 1973 Yom Kippur War. The first requirement of an effective decentralized system is that it be made up of self-contained subordinate units. By 1973, overreliance on tanks meant that units were less capable of dealing with unforeseen circumstances. For example, pure armor units required attachments of mechanized infantry and self propelled artillery to deal with the initial Egyptian bridgehead. These units were thus more reliant on higher headquarters to provide necessary assets.⁶⁶ This, in turn, required more two-way communication and raised the decision threshold a step higher than had been the case in either '56 or '67. Another problem—perhaps the most important

one—was the fact that the war did not go according to any prepared plan.

The Egyptian surprise attack forced the Israelis to change their counterattack plan at the very beginning of the war. Contingency plans that specified control measures and designated objectives for semi-independent subordinate units almost immediately became obsolete due to the surprise attack launched by the Egyptians. Israeli commanders had to evaluate the new situation based on incomplete data, process the input, and issue new orders in a timely manner. In other words, the situation demanded a more traditional C² structure. Since their plan was to let subordinates make their own decisions, their system did not have adequate tools in place to gather data through the pipeline or query modes. No system of "directed telescopes" was in place as was the case during the '67 war. Key decisions had to be made at the top by the man who knew the least about what was actually going on in the field. The result was a clumsy effort that failed due to a breakdown in information flow. Instead of a decentralized system perfectly suited to modern mobile warfare, one historian dubbed the '73 effort "reverse optional control".⁶⁷ The main lesson is that extreme decentralization has many advantages especially in timeliness; however, the traditional two-way communications system cannot be ignored, especially when the situation requires major changes due to battlefield circumstances or political considerations. Both of these circumstances are likely to be present in conflicts involving U.S. forces.

Synthesis. Theory and History

Our review of several theories and selected historical experiences provide some food for thought as we prepare to evaluate current and future requirements. Starting from the most general to the specific, we have to conclude that a successful modern information management system must first consider every possible way to reduce the amount of information that must be transferred. The best way to do this is through a decentralized system in which subordinates are given mission-type orders. This was impossible during World War One due to the rigid, centrally planned link between the maneuver commander and his supporting artillery. The introduction of the radio allowed subordinate commanders to operate with more autonomy. Lower level decision making has generally been the best way for commanders to cope with the uncertainty of mobile warfare. The limits of this approach can be seen in the Israeli experience of 1973 when the need to coordinate actions between independent subordinates proved difficult under their system of "optional control."

Theory and history have also identified several trends that should be considered as we look for ways to increase the tempo in the future. The amount of information that the tactical commander must consider has grown continuously in this century. Until the computer age, the only way to cope with this increased demand for processing was to increase the size of the staff. Larger staffs, however, require more coordination and thus take longer to complete the estimate process. Their slowness can result in plans and orders that are rapidly overcome by events. Larger staffs also require more vehicles

and equipment and are thus less mobile. Both theory and history suggest that the answer is not to increase the size of the staff.

Several ways to keep the staff size at manageable levels can also be discerned from the examples we have studied. First, when staff officers are not as specialized, fewer people are required since each can do more than one narrow job. Patton's G-2 (an ex-cavalry officer) is an example of this.⁶⁸ Second, stability in staff assignments allows people to get to know each other and thus reduces the requirement for coordination. Patton kept key personnel with him when he changed command⁶⁹. This was a proven technique for keeping staffs small. Consider, for example, Colonel Marshall's experience in the First World War:

As everyone had become better accustomed to his duties in the Operations Section, it became possible to materially reduce the number of officers, and I released ten or fifteen for assignment to other places.⁷⁰

These examples suggest that that stability allows a staff to be small and still get the job done.

Theory and history also suggest several other ways to speed information flow. When commanders are forward they can drastically reduce the amount of communications required and their personal observations greatly reduce uncertainty. Since the modern battlefield is usually too large for an individual to physically observe, a system of "directed telescopes" similar to Patton's "Household Cavalry" and daily staff officer visits to subordinate units seem to work well. These trained and trusted aides provide filtered information from critical areas of the battlefield and they reduce uncertainty for the

commander since he knows and trusts the people providing the information.

While this short paper does not pretend to contain a comprehensive list of ways to improve tactical information management, the insights outlined above should serve as a starting point for considering contemporary problems and future needs.

IV. Contemporary and Future

The key ingredient at all stages of the process is information -- timely, accurate, germane and useful information on friendly and enemy forces, and the environment in which they operate. With the wealth of raw data available, especially with the proliferation of ADP, systems, information management is absolutely critical to sound decision making.⁷¹

Army Command and Control Master Plan

Current

In this section we will consider the performance of our current information processing systems. Essentially we seek to know how we are doing so that we can better decide where to go from here. The standard we will apply is the one spelled out in the introduction as evaluation criteria: **"The ultimate measure of command and control effectiveness is whether the force functions more effectively and more quickly than the enemy."** My main sources for feedback on how current systems perform are Battle Command Training Program (BCTP) results and DESERT STORM after action reports. In order to go at this problem in a logical way, I will use the OODA Loop with its connecting threads as an outline to address specific functions (see Appendix A, Fig. A-2).

Observe-Orient

History and theory agree that best place for the commander is forward where he can "see" the battlefield. DESERT STORM was no exception. Both the Commanding General (CG) and the G-3 of the First Infantry Division (Mechanized) controlled the battle from M-1 tanks.⁷² Major General McCaffrey of the 24th Infantry Division (Mechanized) fought from an M-2 Bradley. He was so far forward that his vehicle participated in a direct fire-fight.⁷³ The commander's dilemma is whether he can he maintain control of his entire force while he reaps the benefits of being forward. We saw that in the First World War commanders were tied to their field phones where they became instantly isolated. During the Second World War, the radio allowed commanders to be forward and still maintain control. The radio remained the primary communications system for commanders in the Gulf, but new technologies caused some problems.

One of the most significant problems of the war was the lack of an adequate C² vehicle. Not only can current vehicles not keep up, but they also lack adequate communications equipment to keep the commander in touch with both higher headquarters and subordinate units. Divisions were only issued two Tactical Satellite Communications Systems (TACSAT)—one for the tactical command post (TAC CP) and one for the division main (TOC). Since this was the only system capable of maintaining contact over the required distances, the CG had to relay through the TAC to communicate with higher and adjacent units.⁷⁴

Another example of communications deficiency was the downlink data from Joint Surveillance Target Attack Radar System (JSTARS). This new system promises to provide immediate, accurate intelligence information to maneuver commanders—Clausewitz's dream. Major General Funk of the 3rd Armored Division reported that the information acquired by this new system was invaluable but not readily available. He concluded that commanders needed a real time JSTARS display in their forward command vehicles. Instead, he had to rely on bootleg information sent to him by a couple of his "spies" back at 3rd Army.⁷⁵ If we do not recognize this need and develop appropriate equipment, our commanders might become tied to their TACSAT or JSTARS downlinks like the "chateau generals" of the First World War were tied to the telephone.

Since modern mechanized commanders cannot physically observe the entire battlefield—especially in the desert—they still need "directed telescopes" to help them stay informed. Most units in the Gulf War realized this immediately and "[liaison] Officers" were used throughout the battlefield at all levels from lower to higher, with adjacent units, coalition partners and internally.⁷⁶ Many units noted in their DESERT STORM after action reports that current tables of organization and equipment (TO&E) do not provide enough LOs. Since LO teams were hastily assembled after the emergency began, they could not perform as well as permanently assigned officers who are well acquainted with their units and commanders. The after action reports do not indicate whether LOs were employed like Patton used his

"household cavalry", but the requirement is valid and should be resourced in peacetime.⁷⁷

Orient-Decide

The connecting thread between orient and decide consists of all elements of the staff process. Personnel, equipment, and doctrine all play a part in the functions performed under this heading.

The standard response of military organizations when confronted with an increased workload is to increase the size of the staff. We saw this in both the First and Second World Wars.⁷⁸ DESERT STORM was no different. The Center for Army Lessons Learned DESERT STORM after action report states bluntly that, "CPs are not resourced with sufficient personnel and equipment to operate during sustained and continuous operations."⁷⁹ Units corrected this problem by increasing command post personnel between 10 and 100%.⁸⁰ No doubt part of these additional people were not added to fill a requirement, but were there because the Gulf was the only war in town at the time. The real questions we need to consider are: (1) do we really need this many people to do the job, and; (2) what does this increase in size do to our mobility?

The answer to the second question is that bloated staffs make TOCs even less mobile. FM 100-15-1 claims that the current heavy corps TOC is "too big; too difficult to move; too easily detected through physical, electronic, and thermal signatures; and too readily destroyed once located."⁸¹ Just prior to the war, the Army's Standardized Command Post action officer wrote, "It is commonly held today that the typical CP has become too big, it is difficult to move and is easily

detected"⁸² And these comments are based on the current "inadequate" TO&E! DESERT STORM proved them right. The VII Corps main command post never moved during the war. Many of the divisions decided before the land war began that they would not even attempt to move their TOCs.⁸³ Current doctrine writers believe that in a general war CPs may have to move as often as twice in a 24 hour period. Patton's Army headquarters actually moved every other day during the dash across France. Based on these norms, our current capability appears inadequate.⁸⁴

Let us now turn to the first question: do we really need more people in our TOCs to do the job? Whether needed or not, additional officers will find something to do. Much of that something traditionally has been to produce paper.⁸⁵ Civilian efficiency experts agree that when it comes to rapid decision making, smaller is better.⁸⁶ The only feasible alternative to larger staffs for the U.S. Army today is automation of labor intensive tasks. Much of this labor intensive work takes place in the physical reproduction of an order and logically fits with our discussion of the decide-act portion of the cycle.

Before I discuss orders production, however, two other aspects of the staff process deserve mention. The first is the personnel assignment policy. One brigade that participated in DESERT STORM noted that due to force reduction, their personnel had been frozen approximately nine months prior to being alerted for the Gulf. They attributed their command and control success to leader stability.⁸⁷ This tracks with the conclusions drawn from BCTP as well, and argues for some sort of program that would have the assignments of staffs

and commanders more closely linked.⁸⁸ In our next conflict, we may not have six months to train together and form the cohesive staffs we need.

The second point concerning staff procedures is our doctrine for the staff estimate itself. Some argue that the multi-step staff estimate process as taught at the Command and General Staff College is inappropriate for the rapid decisions required by the modern battlefield.⁸⁹ This critique may have some validity since ten years of experience at the National Training Center for battalions and brigades have resulted in an abbreviated estimate process at those levels.⁹⁰ BCTP has only been in operation since 1987. More experience with these large unit exercises may prove that the process is also too slow for divisions and corps.

Another more basic concern is that our command doctrine is inappropriate for modern mobile warfare. Despite the words written in manuals such as 100-5, our staff procedures are not specifically designed to function in the chaos of modern mobile warfare. Both the German experience from World War Two and parts of the Israeli "optional control" system seem to deserve more study.⁹¹ This subject, of course, is a good topic for another complete monograph, so let us get back to the topic at hand and consider the next step in the decision cycle.

Decide-Act

Overlay reproduction and distribution is one of the most time consuming problems that staffs face in putting out completed opera-

tions orders (OPORDs). To appreciate how far we have come on this issue, compare our capabilities in World War Two with those of today.

In his memoirs, General Patton's G-2 explained how difficult it was to make acetate copies of the daily intelligence map. Early in 1944, they developed an "automated" system that allowed them to get information out faster. Colonel Koch had a photographer take a picture of the updated map. He then attached an 8x10 copy to the daily intelligence update. According to Koch:

This not only overcame the tedious task of copying but also eliminated the problem of filing the bulky paper overlays Of even greater importance, additional copies could readily be made and disseminated.⁹²

Colonel Koch's 45 year old system was still state of the art in 1991.

While the Army teaches and emphasizes the rapid generation of orders and plans, our equipment does not support this goal. Almost every level of command from battalion to army complained that "we consume valuable time copying the orders by hand and hand delivering them to lower, adjacent, and higher units."⁹³ If current forces must synchronize more systems than units in the past, and if we hope to cycle through our OODA Loop faster than the enemy, then our equipment should be designed to support the process. Unfortunately, current automation equipment does not fill the requirement.

The first piece fielded of the automated Army Tactical Command and Control System (ATCCS) was less than a complete success. The highly touted Maneuver Control System (MCS) is supposed to have the graphics and text transfer capability that would have solved the

problem of overlay and order transmission. Units that used it during the Gulf War were disappointed:

Because of a variety of problems MCS cannot provide timely information during normal command post operations. MCS' excessive power requirements, interface and software problems, complexity, bulky size, and maintenance unreliability combined to make the system inadequate to support the commander.⁹⁴

Based on the performance of MCS, we can understand why DESERT STORM units demanded more people to do the job. Just as in the past, when the amount of information that must be processed increases, more hands are the only solution when appropriate automation is not available.

One significant automation success story that significantly reduces a commanders uncertainty is the Global Positioning System (GPS). From the time Sun Tzu warned commanders to "know yourself", to the Israeli counterattack that failed five miles east of where it should have been in 1973, knowing the real disposition of friendly troops has been a significant asset. Efforts to link GPS into an automatic reporting system promise to make this knowledge standard procedure in the future. DESERT STORM veterans almost unanimously claim that GPS was one of the war-winning systems. If he were alive today, Clausewitz would have to add GPS to his list of "lubricants" that help to reduce friction.⁹⁵

Our current doctrine and equipment were phenomenally successful against Iraqi forces in the Gulf War and the shortcomings described above are not intended to belittle the accomplishments of our soldiers or leaders. To keep the proper perspective, however, one

might do well to consider Martin Van Creveld's paraphrase of Moltke's comments after the successful 1866 campaign:

Faced with a different adversary from the one just defeated, the army might find that these shortcomings [concerning command and control] could lead to "serious dangers." From a commander who had just gained a triumph of this kind, these were sober words indeed⁹⁶

Future

The document that currently describes how Army forces will operate in the future is TRADOC PAM 525-5 dated 1 August 1991. Since this document "sets the general azimuth for evolution of doctrine, organization, training, material, and leader development" it is a good place for us to start considering how tactical information will be managed in the future.⁹⁷

The main tactical characteristics of AirLand Operations are its offensive orientation, non-linearity, and speed. All of these seem to call for command and control systems that have the characteristics of the most mobile armored warfare of the recent past. Under the heading of command and control, the pamphlet notes that, "The pace and accuracy of information flow on the battlefield must be greatly improved. We must be capable of transmitting and using information on the move."⁹⁸ The section on leader development states that nonlinear battle will stress leaders more than the structured, linear type of past wars. It goes on to note that, "The pace and dispersion of nonlinear operations will also require leaders who know how to use information management decision aids systems."⁹⁹ Overall, the battlefield envisioned by the doctrine writers seems to resemble the same

type of battle that the German *Auftragstaktik* and the Israeli "optional control" systems were developed for.

The nonlinear battlefield is more open, less structured, more fluid, with changes occurring more rapidly than on a linear battlefield. Understanding of commander's intent and concept (mission tactics) are more important and must be an inherent part of the command and control system on the less structured battlefield.¹⁰⁰

These conclusions suggest that our study of past conflicts with emphasis on mobile operations has some value in helping us understand the fast paced, chaotic battlefields of the future. Since many of the lessons learned from past experience still apply, we should do our best to consider them as we look to the future. The similar experiences of Guderian, Patton, Gavish, and Schwarzkopf suggest that most changes will be evolutionary rather than revolutionary.

V. Conclusions

During high tempo combat, mission orders are a standard method by which commanders at all echelons exercise command and control.¹⁰¹

TRADOC PAM 525-2

Throughout this study we evaluated various information processing systems with respect to the criteria established by our current FM 100-5: **"The ultimate measure of command and control effectiveness is whether the force functions more effectively and more quickly than the enemy."**¹⁰² With this as our indicator of success or failure, we looked at several theoretical "ideal" systems, some relevant historical examples, and at our current and proposed future systems. My intent in this section is to quickly review conclusions from each section and answer the question: so what?

In the theory portion we looked at three nested concepts. The RAND study suggests that a suitable C² system must be a hybrid one that uses pipelines, alarms, and trees to acquire information. If we had to choose one above another, high tempo mobile warfare seems to require a rapidly responding tree or query system to work effectively. Colonel Boyd's OODA Loop concept, with the addition of the connecting threads, is a good model for analyzing the information process and exactly describes the importance of a rapid decision cycle in maneuver warfare. And finally, Van Creveld's theory established a precondition that any successful C² system must be based on a decentralized concept. All three theories seem to be compatible with our initial criteria. They give us a good basis for evaluating three relevant historical experiences.

We looked for insights from three eras: WW I, WW II, and the Arab-Israeli Wars. Since our current staff organization evolved from our World War One experience, it seemed like an appropriate place to begin. The First World War also establishes something of a baseline, since it represents the extreme opposite of maneuver war theory. It also taught us that in a stationary conflict, staffs grow and collect more and more data of less and less value. The primary information mode was the pipeline, and it proved inadequate as soon as units moved away from fixed positions.

World War Two continued some trends and developed some new ones. One trend that continued was the growth of the staff in the face of increasing complexity. It takes more people to process more information unless we have reliable automated aids or we reduce the

amount of information to be processed. The best armored commanders did everything they could to cut the amount of staff work. They did this by decentralization, by commanders forward, by use of "directed telescopes" and by relying primarily on the tree or query mode of information transfer. Several "lessons learned" concerning the staff manning include keeping them small, stable, and less specialized. We rounded out our historical investigation with a quick evaluation of the Arab-Israeli experience.

The Arab-Israeli Wars deserve our attention since they are the most recent examples of mobile armored warfare. In the Israeli concept of "optional control," we see an extreme form of decentralization that does not seem to fit our most dangerous future scenarios. The remaining lessons from this period basically support the conclusions from World War Two.

DESERT STORM and BCTP results confirm many of the theoretical concepts as well as almost all the lessons learned from history. Commanders operating forward once again proved their worth. Problems with long range communications on the move threaten to hobble the commander to a communications node in the rear just as "telephonitis" did in World War One. A capability for command and control on the move must be one of our future priorities. "Directed telescopes" in the form of liaison officer teams again played an important part in the conflict. Hopefully, we will learn the lesson this time and provide for these spaces in peacetime as well as in times of crisis. We learned again that without any increase in processing capability, staffs will grow to keep up with the increasing workload. Our current

systems including MCS, mimeograph machines, and hand drawn acetate overlays are not adequate to the task and the huge staffs from the Gulf War somewhat reflect this failure. On the other hand, innovations such as GPS look like revolutionary breakthroughs that reduce uncertainty as no other equipment has in history. This most recent experience has given us an excellent "known point" from which to shoot an azimuth to the future if we only learn the expensive lessons we have recorded.

This paper began by asking whether our tactical information processing system is suitable for current AirLand Battle doctrine and future AirLand Operations. I believe the performance of our current system in DESERT STORM and in BCTP exercises indicate serious flaws that could prevent our large units from being as agile as they need to be on the battlefields of the future. Based on our extensive effort to collect data from the recent war and continuing lessons from BCTP, we should be able to man, equip, and train an information processing system suitable for AirLand Operations of the future.

APPENDIX A

	Pipeline	Alarm	Tree
When Sent?	Supply push	Upon Detection	Demand Pull
What Sent?	Predetermined(SOP)	Alert	Situation Dependent
Time	Not time sensitive	Very time sensitive	Usually time sensitive
Data Universe	All rpts and obsv Implicit (large #)	Explicit (small #)	Very large, anything a commnader could ask
Purpose	Set the stage, context • Anticipate • Identify • Solve Problems	Alert the cdr that his plan requires change	Prime souce of info for critical decisions
Example	CDR's SITREP	CCIR	Data Search, RFI
Drawback	Cannot respond quickly to unantici- pated info	Implicit alarms de- pend on training of staff, cdr's intent	Can take too long to get info if in reactive mode

Figure A-1, Pipeline, Alarm, Tree Comparison

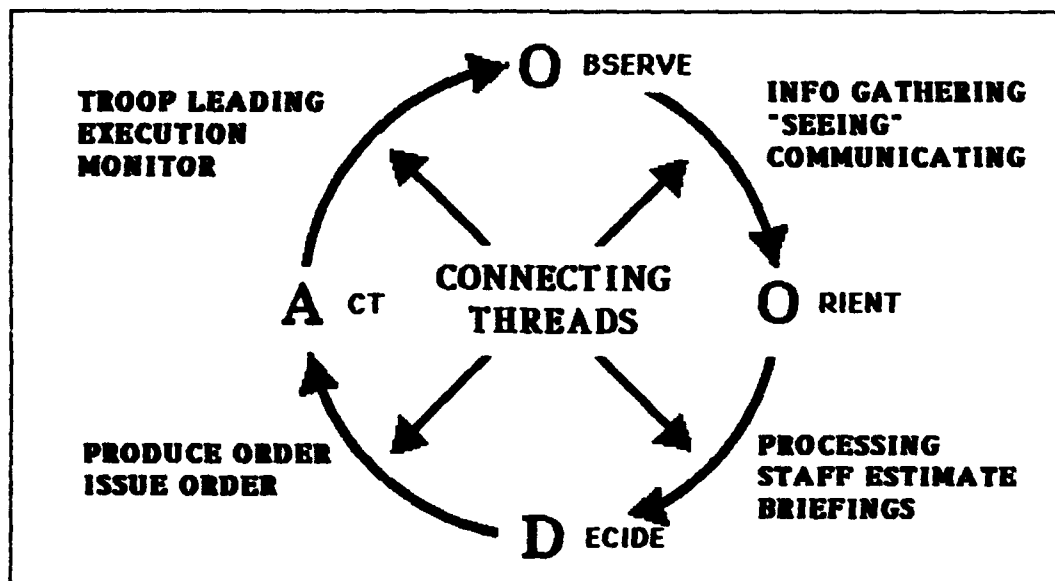


Figure A-2, Colonel Boyd's OODA LOOP

(Note the idea of connecting threads are my addition to Col Boyd's theory)

Endnotes

¹ Lieutenant Colonel Thomas D. Morgan (USA Ret), "BCTP Training Leaders," *Military Review* 71 (July 90): 50.

² Richard E. Simpkin, *Race to the Swift: Thoughts on Twenty-First Century Warfare* (London: Brassey's Defence Publishers, 1985), 263.

³ U.S. Army, *FM 100-5, Operations*, (Washington, DC: Department of the Army, 1986), 14-18.

⁴ Ibid., 22.

⁵ Carl von Clausewitz, *On War*, ed. and trans. by Michael Howard and Peter Paret (Princeton, NJ: Princeton University Press, 1976), 132.

⁶ James P. Kahan, D. Robert Worley, Cathleen Stasz, *Understanding Commanders' Information Needs*, (Santa Monica CA: RAND Corporation, 1989), 15. This study explains the concept of the commander's image ("an internal model, or image, of what reality is") in some detail.

⁷ John Keegan, *The Mask of Command* (New York: Viking Penguin Inc., 1987; Penguin Books, 1988), 325-326.

⁸ Sun Tzu, *The Art of War*, trans. by Samuel B. Griffith (New York: Oxford University Press 1963; paperback edition 1982), 84. Simpkin's comments on how the lack of knowledge impacts on tempo are also interesting and relevant to my argument. Simpkin, 112.

⁹ Clausewitz, *On War*, 102.

¹⁰ Ibid., 117.

¹¹ Ibid., 104. The other three are danger, exertion, and chance. See also, G. B. Griffin, *The Directed Telescope: A Traditional Element of Effective Command*, CSI Report No. 9 (Fort Leavenworth, KS: Combat Studies Institute, U.S. Army Command and General Staff College, 1985), 29. Concerning uncertainty see also Carl von Clausewitz,

Principles of War, in *Roots of Strategy Book 2* (Harrisburg PA: Stackpole Books, 1987), 365-7.

¹² Clausewitz, *On War*, 102.

¹³ Van Creveld's argument is neatly summarized by Keegan in *The Mask of Command*, 326.

¹⁴ Martin Van Creveld, *Command In War* (Cambridge Mass.: Harvard University Press, 1985), 267.

¹⁵ Ibid., 1.

¹⁶ Chris Bellamy, *The Evolution of Modern Land Warfare: Theory and Practice* (New York: Routledge, 1990), 47. See also diagram of increase in size of battlefields 1805-1945, 62. Information on size of armies, 61. Diagram reference spectrum of technologies, 51.

¹⁷ Kahan, 2, 5, 6.

¹⁸ Ibid., 6.

¹⁹ Clausewitz, *On War*, Book Two Chapter Two in general. Specifically, 136, 152. Antoine Henri Jomini, *Jomini and his Summary of the Art of War* in *Roots of Strategy Book 2* (Harrisburg PA: Stackpole Books, 1987), 436-37.

²⁰ This theory has been adopted by the Concepts and Doctrine Directorate, US Army Command and General Staff College and is included in the division tactics and techniques manual. See U.S. Army, *Field Manual 71-100-1 (coordinating draft), Armor and Mechanized Division Operations Tactics and Techniques* (Washington, DC: Department of the Army, May 1991), 2-11.

²¹ Kahan, viii, 37, 41.

²² Ibid., 41. See also Morgan, 50 and Major Thomas B. Giboney, "Commander's Control From Information Chaos," *Military Review* 71 (November 1991): 34.

²³ Kahan, 42-43, 55. *FM 71-100-1*, 2-11.

²⁴ Van Creveld, 272.

²⁵ The RAND study did not specifically address the idea of commanders forward. This is an important technique because when the commander directly observes actions, the amount of information that must be communicated is greatly reduced. Kahan, 44-46. *FM 71-100-1*, 2-11. See also Stephen E. Runals, "Command and Control: Does Current U.S. Army Tactical Command and Control Doctrine Meet the Requirement for Today's High Intensity Battlefield" (Monograph, U.S. Army Command and General Staff College, School of Advanced Military Studies, 1985. DTIC No. ADA167 258

²⁶ U.S. Army, *Field Manual 71-100, Division Operations* (Washington, DC: Department of the Army, May 1990), 3-2, "Direct leadership during the course of the battle through the commander's personal presence well forward on the battlefield is preferable to control from a commander and staff physically removed from the scene of action." See also, U.S. Army, *Field Manual 100-15, Corps Operations* (Washington, DC: Department of the Army, September 1989), 4-2. Also, General Crosbie E. Saint, "Commanders Still Must Go See," *Army* 41 (June 1991): 22, 26.

²⁷ Van Creveld coined the term in, *Command* 75. For a more extensive treatment see Griffin, "Directed Telescope," *passim*.

²⁸ Reference the "keep 'em honest" role for "directed telescopes" see Van Creveld, 75.

²⁹ Captain William D. Blackledge and Captain Jose A. Torres, "M[ilitary] R[evue] CALL Forum," *Military Review* 70 (July 1990): 90.

³⁰ Kahan, ix, 46. *FM 71-100*, 2-11.

³¹ Note the similarity between "observe" and Sun Tzu's basic information requirements. See footnote 8 above.

³² William S. Lind, *Maneuver Warfare Handbook* (Boulder CO: Westview Press, Inc., 1985), 4-5. The OODA Loop has been adopted by

the U.S. Army as a basic theoretical construct. U.S. Army, *TRADOC Pam 11-9, Army Programs Blueprint of the Battlefield*, (Washington, DC: United States Army Training and Doctrine Command, 27 April 1990), 24, 30. The four points of the TRADOC cycle are: Acquire and communicate information; Assess situation; Determine actions; Direct and lead subordinate forces.

³³ Van Creveld, 269.

³⁴ Ibid.

³⁵ Clausewitz, *Principles of War*, 371.

³⁶ Keegan refers to "Chateau generalship" in, *Mask of Command*, 331, 334.

³⁷ U.S. Army, *Field Manual 100-15-1, Corps Operations Tactics and Techniques, Coordinating Draft* (Washington, DC: Department of the Army, April 1991), 2-1.

³⁸ William R. Griffiths, *The Great War*, in the The West Point Military History Series, ed. Thomas E. Griess (Wayne NJ: Avery Publishing Group Inc., 1986), 72.

³⁹ Ibid., Haig quoted in, 153.

⁴⁰ Haig quoted in Lyn MacDonald, *Somme* (London: Michael Joseph Ltd., 1983), 70. Quote concerning "waves" from John Keegan, *The Face of Battle* (New York: The Viking Press, 1976), 244.

⁴¹ Kahan, 82.

⁴² George C. Marshall, *Memoirs of my Service in the World War: 1917-1918*, with a Forward and notes by Brigadier General James L. Collins, Jr. (Boston: Houghton Mifflin Co., 1976), 184-185.

⁴³ The Germans did this best. See Timothy T. Lupfer, *The Dynamics of Doctrine: The Changes in German Tactical Doctrine During the First World War*, Leavenworth Paper No. 4 (Fort Leavenworth KS:

Combat Studies Institute, U.S. Army Command and General Staff College, 1981), 42. Van Creveld, 184.

⁴⁴ Van Creveld, 167. Haig had no directed telescopes at Somme. Griffin, 15.

⁴⁵ Brigadier General J. D. Hittle, *The Military Staff: Its History and Development* (Harrisburgh PA: Military Service Division, Stackpole Co., 1944; reprint Westport CT: Greenwood Press, Publishers, 1975), 210. See also, *FM 100-15-1*, 2-1.

⁴⁶ Bernard Law Montgomery, *The Memoirs of Field-Marshal The Viscount Montgomery of Alamein*, K. G. (London: Collins, 1958), 36.

⁴⁷ John Keegan, *The Face of Battle* (New York: The Viking Press, 1976), 329-30 for discussion of commanders forward.

⁴⁸ Major Bruce R. Pirnie, *Division and Corps Command Posts in World War II* (Washington D.C.: U.S. Army Center of Military History, 1986), 10. DTIC AD-A167 405.

⁴⁹ I recognize that Patton was an Army commander but since a modern Heavy Corps has almost twice as many men as did Third Army, I do not think it is out of line to compare his command and control system to those of the modern corps.

⁵⁰ Russell F. Weigley, *Eisenhower's Lieutenants: The Campaign of France and Germany, 1944-1945* (Bloomington IN: Indiana University Press, 1981), 438.

⁵¹ Hanson W. Baldwin, *Tiger Jack*, with an introduction by General Jacob L. Devers (Ft. Collins CO: The Old Army Press, 1979), 145-46.

⁵² Ibid., 156.

⁵³ Ibid., 27.

⁵⁴ Ibid., 41. Recollections of Major General Holmes Dager, Commander CCB, 4th AD.

⁵⁵ George S. Patton, Jr. *War As I Knew It*, with annotations by Colonel Paul D. Harkins (Boston: Houghton Mifflin Co., 1947), 354.

⁵⁶ Baldwin, 42.

⁵⁷ Ibid., 39-40.

⁵⁸ Colonel Robert S. Allen, *Lucky Forward: The History of Patton's Third U.S. Army*, (New York: The Vanguard Press, Inc., 1947), 34. See also Patton, 361.

⁵⁹ Quote from Ladislav Farago, *Patton: Ordeal and Triumph* (New York: Obolensky, 1964), 493. Other information on Patton's "household cavalry" in Griffin, 23.

⁶⁰ Allen, 47.

⁶¹ Ibid., 47. Pirnie, 11. Pirnie notes that commanders often took their chiefs of staff and operations officers with them to their new commands.

⁶² Allen, 49. For Koch's subsequent career see introduction to: Brigadier General Oscar Koch with Robert G. Hays *G-2: Intelligence for Patton* (Philadelphia, PA: Whitmore Publishing Co., 1971).

⁶³ Patton quoted in Bolger, 76.

⁶⁴ Rabin quoted in Van Creveld, 198.

⁶⁵ Edward N. Luttwak and Daniel Horowitz, *The Israeli Army, 1948-73* (New York: Allen Lane, 1975; reprint, Cambridge, Mass.: Abt Books, 1983), 162.

⁶⁶ Van Creveld, 204.

⁶⁷ Ibid., 228.

⁶⁸ For other comments concerning the problems with overspecialization see: Van Creveld, 141.

⁶⁹ Kahan, p. 78. BCTP command seminars seek to build cohesion in staffs before a WARFIGHTER exercise. Morgan, 50-52. Pirnie, 11, 17.

⁷⁰ Marshall, 182.

⁷¹ U.S. Army, *Army Command and Control Master Plan, Volume I*, (Fort Leavenworth, KS: Combined Arms Combat Developments Activity, 1990), 3-21.

⁷² U.S. Army, Center For Army Lessons Learned (CALL), Fort Leavenworth KS, *VII Corps Desert Campaign After Action Report (VII Corps AAR)*, Part 3, Volume 11B, 1st Infantry Division (Mech), Annex E, Lessons Learned, dated 19 March 1991, p. 22 (The Current Command Post Concept And Equipment Will Not Work During A Fluid, Mobile Battle).

NOTE On DESERT STORM AAR Information. Operation DESERT STORM Lessons Learned (ODSLL) is the published after action report from the Gulf War. It consists of six volumes and is classified SECRET/NOFORN. Without volume VI the AAR is classified CONFIDENTIAL. Of the remaining volumes, "When taken by itself, the information in any one volume is unclassified." I will refer only to Volume IV, Tactical.

At the time this paper was written, the CALL AAR cell was in the process of scanning all documents into a data base and recording them with a Center for Army Lessons Learned Desert Storm Data Base Number (CALL*). Documents that have not yet been scanned will be referred to by their Joint Universal Lessons Learned Number (JULLS). Until the data base is complete, researchers must look up information in binders. I will include this reference information to these binders in italics. Much of the data is still being declassified. I have cited only unclassified material. When the the remainder is declassified, many more supporting documents will be available for most of the points that I cite here. For convenience, this is a list of abbreviations I will use in citations:

- Operation DESERT STORM Lessons Learned, Vol IV -- ODSLL
- Joint Universal Lessons Learned -- JULLS

- CALL DESERT STORM Data Base Number -- CALL#
- *VII Corps Desert Campaign After Action Report* -- *VII Corps AAR*
- *United States Army Armor Center AAR, Executive Summary, Emerging Observations JULLS, Book 1* -- *Armor AAR*

73 Major General Barrie R. McCaffrey, 24th Infantry Division (Mech), Lecture Delivered at U.S. Army Command and General Staff College, Fort Leavenworth KS, April 1991.

74 U.S. Army, Combined Arms Command, C² Directorate, Memorandum For: ATCCS Pre-ASARC/Army Command and control (ACCS) Management General Officer Steering Committee (GOSC) dated 3 June 1991. Subject: Command and Control (C²) on the Move. See also Message from Brigadier General Tilelli for Lieutenant General Wishart, Subject: AirLand Battle Future, dated 271859Z Dec 90. CALL# DSSN113 0717. See also ODSLL IV-4-5, 4-6 (Issue: CPs are not properly resourced [people, communications, antennas, vehicles, generators, reproduction and overlay capabilities, etc.]); IV-4-16 (Issue: Current C² vehicles cannot keep pace with the maneuver force). IV-4-22 (Issue: Communications systems antennas are not sufficiently sturdy or mobile to support sustained operations). Reference TACSAT see *ARMOR AAR* JULLS 53048-53161 (00430) (Title: Command and control shortfalls), *VII Corps AAR* Part 3, Volume 11B, 1st Infantry Division (Mech), Annex E, Lessons Learned, dated 19 March 1991, p. 20 (FM and Satellite Voice Communications Are Key To Control A Fast Moving Battle) and p. 21 (The Single Channel TACSAT Radio Is a Must At Division Level).

75 Major General Paul E. Funk, 3rd Armored Division, Lecture Delivered at School of Advanced Military Studies, Fort Leavenworth KS, 14 November 1991. 1st Infantry Division also sent "spies" to higher to get info. *VII Corps AAR* Part 3, Volume 11B, 1st Infantry Division (Mech), Annex E, Lessons Learned, dated 19 March 1991, p. 9 (Current Intel Systems Are Not Responsive To The Tactical Commander).

76 ODSLL, IV-4-8.

77 Ibid., "Personnel are inadequately trained during peacetime on the duties and responsibilities of an LO. Commanders lack

confidence in LOs from outside agencies which causes them to want their won people at higher headquarters."

⁷⁸ *FM 100-15-1, 2-2, 2-3*. Staffs also grew during the relatively static Vietnam War.

⁷⁹ ODSLL, IV-4-5.

⁸⁰ Ibid.

⁸¹ *FM 100-15-1, 2-3*.

⁸² Captain Kenneth A. McDevitt, "Why Standardize Command Posts?" *Military Review* 70 (July 1990): 54.

⁸³ Reference VII Corps Main CP see, CALL# DSSN1, Title "Tactical Command Post Observations." (Handwritten worksheet, Observation #017, "Monitoring Corps Battle by Corps Main."). Reference Division CPs see, *VII Corps AAR*, Part 3, Volume 11B, 1st Infantry Division (Mech), Annex E, Lessons Learned, dated 19 March 1991, p. 22 (The Current Command Post Concept And Equipment Will Not Work During A Fluid, Mobile Battle). See also ODSLL, IV-4-5.

⁸⁴ Reference moving twice in a twenty-four hour period see LTC Jack Burkett, "Command and Control: The Key to Winning," *Military Review* 70 (July 1990): 65. Reference Patton's CP moving every other day, see Allen, 52.

⁸⁵ The Germans in WW I fell victim to the same problems as the large, slow Allied staffs. The result was endless forms and reports known as *der paperkrieg* the paper war. Van Creveld, 169.

⁸⁶ Thomas J. Peters and Robert H. Waterman Jr. *In Search of Excellence: Lessons from America's Best-Run Companies* (New York: Harper & Row, Publishers, 1982), 308, 311.

⁸⁷ CALL#DSSN17 2712, (Title: Leader Stability).

⁸⁸ Morgan, 51-52.

89 Bolger, 76-77.

90 U.S. Army, *Orders Guide* (Fort Irwin CA: Brigade Trainers, February 1991), 20. Chapter title "The Abbreviated Command Estimate."

91 See Runals, 33. He gives a good laydown on how our doctrine is inconsistent. "[Our doctrine] seems to place an emphasis on control and management of the uncertainties of war as opposed to the German doctrine and proactive which emphasized command and leadership, taking advantage of the uncertainty and chaos of battle."

92 Koch, 143.

93 ODSLL IV-4-5, CALL FILE # DSSN1 1963 (Title: Overlay Reproduction).

94 ODSLL, IV-4-1. See also *Armor AAR*, JULLS 62457-58059 (00486), (Title: Maneuver Control System).

95 Reference '73 War problem see Van Crevel, 230. *Armor AAR*, JULLS 15839-84500 (00370), (Title: Use of position location devices). The observer concluded that "We would have been lost without them." [pun intended]. Others include *VII Corps AAR*, Part 3, Volume 11B, 1st Infantry Division (Mech), Annex E, Lessons Learned, dated 19 March 1991, p. 2 (The Global Positioning System (GPS) Is A Must For All Leader Vehicles) *ibid.*, p. 14 (The GPS System Is Critical To Logistic Operations).

96 Van Creveld, 140.

97 U.S. Army, *TRADOC Pamphlet 525-5, AirLand Operations: A Concept for the Evolution of AirLand Battle for the Strategic Army of the 1990s and Beyond* (Fort Monroe VA: U.S. Army Training and Doctrine Command, 1 August, 1991), Forward.

98 *Ibid.*, 37.

99 *Ibid.*, 43.

¹⁰⁰ Ibid., 30.

¹⁰¹ Ibid., 47.

¹⁰² *FM 100-5*, 22.

Bibliography

ARTICLES

Blackledge, Captain William D. and Captain Jose A. Torres. "M[ilitary] R[evue] CALL Forum." *Military Review* 70 (July 1990): 89-91.

Bolger, Major Daniel P. "Command or Control?" *Military Review* 70 (July 1990): 69-79.

Burkett, Lieutenant Colonel Jack. "Command and Control: The Key to Winning." *Military Review* 70 (July 1990): 60-68.

Giboney, Major Thomas B. , "Commander's Control From Information Chaos." *Military Review* 71 (November 1991): 34-38.

McDevitt, Captain Kenneth A. "Why Standardize Command Posts?" *Military Review* 70 (July 1990): 54-59.

Morgan, Lieutenant Colonel Thomas D. (USA Ret). "BCTP Training Leaders." *Military Review* 71 (July 90): 42-52.

Saint, General Crosbie E. "Commanders Still Must Go See." *Army* 41 (June 1991): 18-26.

BOOKS

Allen, Colonel Robert S. *Lucky Forward: The History of Patton's Third U.S. Army*. New York: The Vanguard Press, Inc., 1947.

Baldwin, Hanson W. *Tiger Jack*. With an Introduction by General Jacob L. Devers. Ft. Collins CO: The Old Army Press, 1979.

Bellamy, Chris. *The Evolution of Modern Land Warfare: Theory and Practice*. New York: Routledge, 1990.

Clausewitz, Carl von. *On War*. Edited and Translated by Michael Howard and Peter Paret. Princeton, NJ: Princeton University Press, 1976.

- Clausewitz, Carl von. *Principles of War*, Translated and Edited by Hans W. Gatzke in *Roots of Strategy Book 2*. Harrisburg PA: Stackpole Books, 1987.
- Farago, Ladislas. *Patton: Ordeal and Triumph*. New York: Obolensky, 1964.
- Griffiths, William R. *The Great War*, in the The West Point Military History Series, ed. Thomas E. Griess. Wayne NJ: Avery Publishing Group Inc., 1986.
- Hittle, J. D. *The Military Staff: Its History and Development*. Harrisburg PA: Military Service Division, Stackpole Co., 1944: reprint Westport CT: Greenwood Press, Publishers, 1961.
- Jomini, Antoine Henri. *Jomini and his Summary of the Art of War*. in *Roots of Strategy Book 2*. Harrisburg PA: Stackpole Books, 1987.
- Keegan, John. *The Face of Battle*. New York: The Viking Press, 1976.
- Keegan, John. *The Mask of Command*. New York: Viking Penguin Inc., 1987; Penguin Books, 1988.
- Lind, William S. *Maneuver Warfare Handbook*. Boulder CO: Westview Press, Inc., 1985.
- Luttwak, Edward N. and Daniel Horowitz. *The Israeli Army, 1948-73*. New York: Allen Lane, 1975: reprint, Cambridge, Mass.: Abt Books, 1983.
- Macdonald, Lyn. *Somme*. London: Michael Joseph Ltd., 1983.
- Marshall, George C. *Memoirs of my Service in the World War: 1917-1918*. With a Forward and notes by Brigadier General James L. Collins, Jr. Boston: Houghton Mifflin Co., 1976.
- Montgomery, Bernard Law. *The Memoirs of Field-Marshal The Viscount Montgomery of Alamein, K. G.* London: Collins, 1958.
- Patton, George S., Jr. *War As I Knew It*, With Annotations by Colonel Paul D. Harkins. Boston: Houghton Mifflin Co., 1947.

- Peters, Thomas J., and Robert H. Waterman Jr. *In Search of Excellence: Lessons from America's Best-Run Companies*. New York: Harper & Row, Publishers, 1982.
- Simpkin, Richard E. *Race to the Swift: Thoughts on Twenty-First Century Warfare*. London: Brassey's Defence Publishers, 1985.
- Sun Tzu, *The Art of War*. Translated by Samuel B. Griffith. New York: Oxford University Press 1963; paperback edition, 1982.
- Van Creveld, Martin. *Command In War*. Cambridge Mass.: Harvard University Press, 1985.
- Weigley, Russell F. *Eisenhower's Lieutenants: The Campaign of France and Germany, 1944-1945*. Bloomington IN: Indiana University Press, 1981.

REPORTS, MONOGRAPHS, AND STUDIES

- Griffin, G. B. *The Directed Telescope: A Traditional Element of Effective Command*, CSI Report No. 9. Fort Leavenworth, KS: Combat Studies Institute, U.S. Army Command and General Staff College, 1985.
- Kahan, James P., D. Robert Worley, Cathleen Stasz. *Understanding Commanders' Information Needs*. Santa Monica CA: RAND Corporation, June 1989.
- Lupfer, Timothy T. *The Dynamics of Doctrine: The Changes in German Tactical Doctrine During the First World War*, Leavenworth Paper No. 4. Fort Leavenworth KS: Combat Studies Institute, U.S. Army Command and General Staff College, 1981.
- Pirnie, Major Bruce R. *Division and Corps Command Posts in World War II*. Washington D.C.: U.S. Army Center of Military History, 1986. DTIC AD-A167 405.
- Runals, Stephen E. "Command and Control: Does Current U.S. Army Tactical Command and Control Doctrine Meet the Requirement for Today's High Intensity Battlefield?" Monograph, U.S. Army Command and General Staff College, School of Advanced Military Studies, 1985. DTIC No. ADA167 258.

GOVERNMENT DOCUMENTS

- U.S. Army, *Army Command and Control Master Plan, Volume I*, Fort Leavenworth, KS: Combined Arms Combat Developments Activity, 1990.
- U.S. Army. *Field Manual 71-100, Division Operations* Washington, D.C.: Department of the Army, 1990.
- U.S. Army. *Field Manual 71-100-1, Armor and Mechanized Division Operations Tactics and Techniques Coordinating Draft* Washington, D.C.: Department of the Army, May 1991.
- U.S. Army. *Field Manual 100-5, Operations*. Washington, D.C.: Department of the Army, 1986.
- U.S. Army. *Field Manual 100-15, Corps Operations* Washington, D.C.: Department of the Army, September 1989.
- U.S. Army. *Field Manual 100-15-1, Corps Operations Tactics and Techniques, Coordinating Draft* Washington, D.C.: Department of the Army, April 1991.
- U.S. Army, *Operation Desert Storm After Action Report* Fort Leavenworth KS, Center For Army Lessons Learned.
- U.S. Army, *Orders Guide*, Fort Irwin CA: Brigade Trainers, February 1991.
- U.S. Army. *TRADOC Pamphlet 11-9, Army Programs Blueprint of the Battlefield*. Washington, D.C.: Department of the Army, September 1989.
- U.S. Army, *TRADOC Pamphlet 525-5, AirLand Operations: A Concept for the Evolution of AirLand Battle for the Strategic Army of the 1990s and Beyond*. Fort Monroe VA: U.S. Army Training and Doctrine Command, 1 August, 1991.